

## WHAT IS CLAIMED IS:

1           1.    A system for improving performance of wireless  
2   communications comprising:

3               a transmitter producing a modulated data signal  
4   combined with one or more supplemental signals on various  
5   frequencies within a monocarrier channel employed to  
6   transmit the modulated data signal; and

7               a receiver employing the one or more supplemental  
8   signals to compute a frequency domain channel estimate for  
9   use in equalizing the channel during demodulation of the  
10   data signal.

1           2.    The system as set forth in Claim 1 wherein the  
2   one or more supplemental signals each employ a different  
3   frequency which changes during each of a plurality of  
4   periods, wherein the time-varying frequency for each  
5   supplemental signal changes from one period to a subsequent  
6   period in a predetermined sequence of frequencies within  
7   the channel.

1           3.    The system as set forth in Claim 2 wherein the  
2   predetermined sequence spans frequencies within the channel  
3   to directly provide a frequency domain channel estimate.

1           4.    The system as set forth in Claim 2 wherein the  
2   predetermined sequence is coordinated with a field sync  
3   within the modulated data signal.

1           5.    The system as set forth in Claim 2 wherein the  
2   one or more supplemental signals are each transmitted with  
3   a power selected to minimize interference with demodulation  
4   of the data signal without reference to the one or more  
5   supplemental signals.

1           6.    The system as set forth in Claim 2 wherein the  
2   time varying frequency cycles through all frequencies  
3   within the predetermined sequence at a rate sufficient to  
4   permit multiple channel estimates for a single field of the  
5   modulated data signal.

1           7.    The system as set forth in Claim 2 wherein the  
2   predetermined sequence is coordinated with a field sync  
3   within the modulated data signal and wherein the one or  
4   more supplemental signals are each transmitted with a power  
5   selected to minimize interference with demodulation of the  
6   data signal without reference to the one or more  
7   supplemental signals.

1           8. A transmitter for improved wireless communic-  
2 ations comprising:

3               a symbol source producing a data signal;

4               a waveform generator producing a time-varying  
5 signal which changes frequency during each of a plurality  
6 of periods, wherein the frequency changes from one period  
7 to a subsequent period in a predetermined sequence of  
8 frequencies within a channel to be employed in transmitting  
9 the data; and

10              a modulator producing a transmission signal from  
11 a combination of the data signal and the time-varying  
12 signal.

1           9. The transmitter as set forth in Claim 8 wherein  
2 the predetermined sequence spans the channel to directly  
3 provide a frequency domain channel estimate.

1           10. The transmitter as set forth in Claim 8 wherein  
2 the predetermined sequence is coordinated with a field sync  
3 within the data signal.

1           11. The transmitter as set forth in Claim 8 wherein  
2 the time-varying signal is transmitted with a power  
3 selected to minimize interference with demodulation of the  
4 data signal without reference to the time-varying signal.

1           12. The transmitter as set forth in Claim 8 wherein  
2 the time varying signal cycles through all frequencies  
3 within the predetermined sequence at a rate sufficient to  
4 permit multiple channel estimates for a single field of the  
5 data signal.

1           13. The transmitter as set forth in Claim 8 wherein  
2 the predetermined sequence is coordinated with a field sync  
3 within the data signal and wherein the time-varying signal  
4 is transmitted with a power selected to minimize  
5 interference with demodulation of the data signal without  
6 reference to the time-varying signal.

1           14. The transmitter as set forth in Claim 8 wherein  
2 the time-varying signal is one of a plurality of time-  
3 varying signals each having a different frequency during a  
4 period and each changing frequency from one period to a  
5 subsequent period in the predetermined sequence of  
6 frequencies.

1           15. A receiver for improved wireless communications  
2 comprising:

3           an equalizer performing channel equalization on a  
4 received signal utilizing a channel estimate; and

5           a coherent demodulator producing the channel  
6 estimate from the received signal and a time-varying signal  
7 corresponding to a portion of the received signal, wherein  
8 the time-varying signal changes frequency during each of a  
9 plurality of periods, wherein the frequency changes from  
10 one period to a subsequent period in a predetermined  
11 sequence of frequencies within a channel on which the  
12 received signal is received.

1           16. The receiver as set forth in Claim 15 further  
2 comprising:

3           a waveform generator producing the time varying-  
4 signal, wherein a period duration and the predetermined  
5 sequence match a corresponding period duration and  
6 predetermined sequence employed in generating the received  
7 signal.

1           17. The receiver as set forth in Claim 16 wherein the  
2 waveform generator produces a plurality of time-varying  
3 signals each having a different frequency during a period  
4 and each changing frequency from one period to a subsequent  
5 period in the predetermined sequence of frequencies,  
6 wherein the coherent demodulator produces the channel  
7 estimate from the received signal and each of the time-  
8 varying signals.

1           18. The receiver as set forth in Claim 15 wherein the  
2 predetermined sequence spans frequencies within the channel  
3 to directly provide a frequency domain channel estimate.

1           19. The receiver as set forth in Claim 15 wherein the  
2 predetermined sequence is coordinated with a field sync  
3 within the received signal.

1           20. The receiver as set forth in Claim 15 wherein the  
2 time varying frequency cycles through all frequencies  
3 within the predetermined sequence at a rate sufficient to  
4 permit multiple channel estimates for a single field of the  
5 received signal.

21. The receiver as set forth in Claim 15 further comprising:

a channel estimate post-processor smoothing the channel estimate, tracking time varying fades within the channel estimate, and producing Doppler estimates for the channel estimate.

| Variable               | Mean | SD   | Min | Max  |
|------------------------|------|------|-----|------|
| Age                    | 34.5 | 10.5 | 20  | 55   |
| Gender                 | 0.5  | 0.5  | 0   | 1    |
| Marital status         | 0.5  | 0.5  | 0   | 1    |
| Education              | 12.5 | 1.5  | 10  | 15   |
| Income                 | 1500 | 500  | 500 | 3000 |
| Health status          | 0.5  | 0.5  | 0   | 1    |
| Smoking status         | 0.5  | 0.5  | 0   | 1    |
| Alcohol consumption    | 0.5  | 0.5  | 0   | 1    |
| Exercise frequency     | 0.5  | 0.5  | 0   | 1    |
| Stress level           | 0.5  | 0.5  | 0   | 1    |
| Life satisfaction      | 0.5  | 0.5  | 0   | 1    |
| Work satisfaction      | 0.5  | 0.5  | 0   | 1    |
| Family satisfaction    | 0.5  | 0.5  | 0   | 1    |
| Community satisfaction | 0.5  | 0.5  | 0   | 1    |
| Overall satisfaction   | 0.5  | 0.5  | 0   | 1    |

1           22. A method of wireless communication comprising:  
2           combining a data signal with one or more  
3 supplemental signals on various frequencies within a  
4 monocarrier channel; and  
5           employing the one or more supplemental signals to  
6 compute a frequency domain channel estimate for use in  
7 equalizing the channel during demodulation of the data  
8 signal.

1           23. The method as set forth in Claim 22 wherein the  
2 step of combining a data signal with one or more  
3 supplemental signals on various frequencies within a  
4 monocarrier channel further comprises:

5           combining the data signal with one or more  
6 supplemental signals each employing a different frequency  
7 which changes during each of a plurality of periods,  
8 wherein the time-varying frequency for each of the supple-  
9 mental signals changes from one period to a subsequent  
10 period in a predetermined sequence of frequencies within  
11 the channel.



1           24. The method as set forth in Claim 23 further  
2 comprising:

3                 periodically changing a frequency for each  
4 supplemental signal in a predetermined sequence spanning  
5 frequencies within the channel to directly provide a  
6 frequency domain channel estimate.

1           25. The method as set forth in Claim 23 further  
2 comprising:

3                 coordinating the predetermined sequence with a  
4 field sync within the data signal.

1           26. The method as set forth in Claim 23 further  
2 comprising:

3                 sweeping each supplemental signal through all  
4 frequencies within the predetermined sequence at a rate  
5 sufficient to permit multiple channel estimates for a  
6 single field of the data signal.

1           27. The method as set forth in Claim 22 further  
2 comprising:

3                 providing each of the supplemental signals with a  
4 power selected to minimize interference with demodulation  
5 of the data signal without reference to the one or more  
6 supplemental signals.

1           28. The method as set forth in Claim 22 further  
2 comprising:

3                 periodically changing a frequency for each  
4 supplemental signal in a predetermined sequence of  
5 frequencies within the channel coordinated with a field  
6 sync within the data signal; and

7                 providing each of the supplemental signals with a  
8 power selected to minimize interference with demodulation  
9 of the data signal without reference to the one or more  
10 supplemental signals.

1           29. A method for improved wireless communications  
2 comprising:

3           producing a data signal;

4           producing a time-varying signal which changes  
5 frequency during each of a plurality of periods, wherein  
6 the frequency changes from one period to a subsequent  
7 period in a predetermined sequence of frequencies within a  
8 channel to be employed in transmitting the data; and

9           producing a transmission signal from a  
10 combination of the data signal and the time-varying signal.

11           30. The method as set forth in Claim 29 wherein the  
12 predetermined sequence spans the channel to directly  
13 provide a frequency domain channel estimate.

14           31. The method as set forth in Claim 29 wherein the  
15 predetermined sequence is coordinated with a field sync  
16 within the data signal.

17           32. The method as set forth in Claim 29 wherein the  
18 time-varying signal is provided with a power selected to  
19 minimize interference with demodulation of the data signal  
20 without reference to the time-varying signal.

33. The method as set forth in Claim 29 wherein the time varying signal cycles through all frequencies within the predetermined sequence at a rate sufficient to permit multiple channel estimates for a single field of the data signal.

1           34. The method as set forth in Claim 29 wherein the  
2 predetermined sequence is coordinated with a field sync  
3 within the data signal and wherein the time-varying signal  
4 is transmitted with a power selected to minimize  
5 interference with demodulation of the data signal without  
6 reference to the time-varying signal.

1           35. The method as set forth in Claim 29 wherein the  
2 time-varying signal is one of a plurality of time-varying  
3 signals each having a different frequency during a period  
4 and each changing frequency from one period to a subsequent  
5 period in the predetermined sequence of frequencies.

1           36. A method for improved wireless communications  
2 comprising:

3           receiving a signal;  
4           producing the channel estimate from the received  
5 signal and a time-varying signal corresponding to a portion  
6 of the received signal, wherein the time-varying signal  
7 changes frequency during each of a plurality of periods,  
8 wherein the frequency changes from one period to a  
9 subsequent period in a predetermined sequence of  
10 frequencies within a channel on which the received signal  
11 is received; and

12           performing channel equalization on the received  
13 signal utilizing the channel estimate.

14           37. The method as set forth in Claim 36 further  
15 comprising:

16           producing the time varying-signal with a period  
17 duration and the predetermined sequence matching a  
18 corresponding period duration and predetermined sequence  
19 employed in generating the received signal.  
20

1           38. The method as set forth in Claim 37 further  
2 comprising:

3           producing a plurality of time-varying signals  
4 each having a different frequency during a period and each  
5 changing frequency from one period to a subsequent period  
6 in the predetermined sequence of frequencies, wherein the  
7 channel estimate is produced from the received signal and  
8 each of the time-varying signals.

1           39. The method as set forth in Claim 36 wherein the  
2 predetermined sequence spans frequencies within the channel  
3 to directly provide a frequency domain channel estimate.

1           40. The method as set forth in Claim 36 wherein the  
2 predetermined sequence is coordinated with a field sync  
3 within the received signal.

1           41. The method as set forth in Claim 36 wherein the  
2 time varying frequency cycles through all frequencies  
3 within the predetermined sequence at a rate sufficient to  
4 permit multiple channel estimates for a single field of the  
5 received signal.

1           42. The method as set forth in Claim 36 further  
2 comprising:

3                 smoothing the channel estimate, tracking time  
4 varying fades within the channel estimate, and producing  
5 Doppler estimates for the channel estimate.

1           43. A wireless communication signal comprising:  
2           a data signal; and  
3           at least one supplemental signal combined with  
4 the data signal, the at least one supplemental signal  
5 having a frequency which changes during each of a plurality  
6 of periods in a predetermined sequence of frequencies for a  
7 channel in which the wireless communication signal is  
8 transmitted.

1           44. The wireless communications signal as set forth  
2 in Claim 43 wherein the predetermined sequence of  
3 frequencies spans the channel.

1           45. The wireless communications signal as set forth  
2 in Claim 43 wherein the predetermined sequence is  
3 coordinated with a field sync within the data signal.

1           46. The wireless communications signal as set forth  
2 in Claim 43 wherein at least one supplemental signal sweeps  
3 the predetermined sequence at a rate sufficient to permit  
4 multiple channel estimates based on the at least one  
5 supplemental signal within a single field of the data  
6 signal.



1           47. The wireless communications signal as set forth  
2           in Claim 43 wherein at least one supplemental signal has a  
3           power sufficiently less than a power for the data signal to  
4           permit demodulation of the data signal without reference to  
5           the at least one supplemental signal.

1           48. The wireless communications signal as set forth  
2           in Claim 43 wherein at least one supplemental signal  
3           further comprises:

4                   a plurality of supplemental signals each having a  
5                   different frequency during a given period and each changing  
6                   frequencies in the predetermined sequence from one period  
7                   to a subsequent period.

1           49. The wireless communications signal as set forth  
2           in Claim 43 wherein wireless communications signal is a  
3           result of modulating the combination of the data signal and  
4           the at least one supplemental signal.